

Total No. of printed pages = 4

ME 181403

Roll No. of candidate

W/C 22

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2022

BINA GROUP OF INSTITUTIONS
(ESTD. & AFFD)
Azara, Hathibaspata,
Guwahati - 781017

B.Tech. 4th Semester End-Term Examination

Mechanical Engineering

FLUID MECHANICS - I

(New Regulation & New Syllabus)

Full Marks - 70

Time - Three hours

The figures in the margin indicate full marks
for the questions.

Answer question No. 1 and any *four* from the rest.

1. Answer the following (MCQ/ Fill in the blanks) : (10 × 1 = 10)
- (i) The kinematic viscosity of a fluid is _____ stokes, If the coefficient of dynamic viscosity of the fluid is 0.5 poise and specific gravity is 0.5.
- (a) 0.25
(b) 0.50
(c) 1.0
(d) None of the above
- (ii) A tank contains water upto 1 m height and 50 cm depth of oil above it. Specific gravity of oil is 0.8. The pressure acting at the bottom of the tank will be in kPa
- (a) 4 kPa
(b) 10 kPa
(c) 12 kPa
(d) 14 kPa
- (iii) The buoyant force line of action acts through the
- (a) Centroid of the volume of fluid vertically above the body
(b) Centre of the volume of floating body
(c) Centre of gravity of any submerged body
(d) Centroid of the displaced volume of fluid

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- (iv) The metacentric height of a passenger ship is kept lower than that of a naval or a cargo ship because
- (a) Apparent weight will increase
 - (b) It will decrease the frequency of rolling
 - (c) Otherwise, it will sink and be totally immersed
 - (d) None of these
- (v) The statement of Euler's Equation of motion shows
- (a) mass conservation
 - (b) energy conservation
 - (c) momentum conservation of inviscid fluid
 - (d) momentum conservation of real fluid
- (vi) The flow through a convergent tapered tube can be assumed as
- (a) steady uniform
 - (b) steady non-uniform
 - (c) unsteady uniform
 - (d) unsteady non-uniform
- (vii) A tank containing liquid has two orifices of the same diameter at depths of 40 cm and 90 m below the free surface. The ratio of discharge through these orifices is
- (a) 1:1
 - (b) 2:3
 - (c) 4:9
 - (d) 16:81
- (viii) In a steady laminar flow in between two parallel plates, the ratio of average velocity to maximum velocity is
- (a) $1/2$
 - (b) $2/3$
 - (c) $3/2$
 - (d) 2
- (ix) In a steady laminar flow through a circular tube the velocity distribution is
- (a) Constant over the cross-section
 - (b) Varies linearly from zero at walls to maximum at centre
 - (c) Varies parabolically with maximum at the centre
 - (d) None of the above

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- (x) If two pipes of same length and diameters d and $2d$ respectively are connected in series. The diameter of an equivalent pipe of same length is
- less than d
 - between d and $1.5 d$
 - between $1.5 d$ and $2d$
 - greater than $2d$

2. (a) Name the fluid properties attributable for the following phenomena:

- Rise of sap in a tree
- Spherical shape of rain drops
- Oil floats in water
- Development of boundary layer
- Cavitation

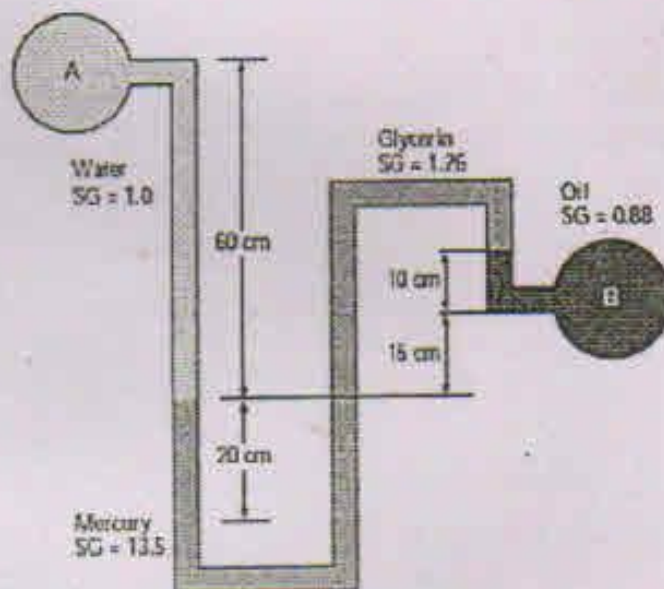
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(b) A hydraulic lift consists of a 30 cm diameter ram which slides in a 30.5 cm diameter cylinder, the annular space being filled with oil having a kinematic viscosity of $0.025 \text{ cm}^2/\text{sec}$ and specific gravity of 0.85. If the rate of travel of the ram is 10 m/min. Determine the frictional resistance when 3.05 m of the ram is engaged in the cylinder. (10)

3. (a) Prove that Pressure in a fluid at rest is independent of shape or cross section of the container. (5)

(b) The pressure difference between an oil pipe and water pipe is measured by a differential manometer as shown in figure. Calculate the pressure difference between Pipe A & B.

Glycerine S.G. = 1.26, Mercury S.G is 13.6 and Oil S.G is 0.88. (10)



4. (a) Explain the term: Metacentre, Centre of buoyancy and three States of equilibrium of a floating body. (5)
- (b) A solid cylinder is to be 0.25m in diameter. The base of axial length 25 mm is to be of metal which has a specific gravity 7, and the remainder of material which has a specific gravity 0.5. Find the maximum over all length of the cylinder in order that it may float in water in the stable equilibrium with its axis vertical. (10)
5. (a) Establish the relation $\Omega = 2\omega$ connecting angular velocity ω and vorticity vector Ω . (5)
- (b) If the expression for the stream function is described by $\phi = x^3 - 3xy^2$ indicate whether the flow is rotational or irrotational. If the flow is irrotational determine the value of the velocity potential. (10)
6. (a) Determine the equation of conservation of mass by vector approach for incompressible fluid. Interpret it physically. (7)
- (b) Water at room temp flows between two parallel plates, one of which is at rest and the other moving with a velocity U . If the volumetric flow Q per unit width is zero, find the relation between U and dp/dx in terms of dynamic viscosity μ and spacing of the plate h . Calculate the pressure gradient for $U=15$ cm/sec and $h=15$ cm. (8)
7. (a) Discuss the Buckingham's pie theorem and significance of dimensionless numbers. (5)
- (b) Two pipes each 300 m long are available for connecting to a reservoir from which a flow of $0.085 \text{ m}^3/\text{s}$ is required. If the diameters of the two pipes are 0.30 m and 0.15m respectively, determine the ratio of the head lost when the pipes are connected in series to the head lost when they are connected in parallel. Neglect minor losses. (10)

